DIFFERENCES IN EXPLOSIVE POWER OF THE LOWER LIMB BOYS OF ADOLESCENT AGE

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Abstract: *The research was carried out with the objective of establishing statistically significant differences between football players of FC "Novi Sad" (N=21) from Novi Sad and students who are not active in sports (N=23) also from Novi Sad, in order to point out the positive effects of training processes on the explosive strength of legs. The battery of 5 motor tests has been applied: Counter Movement Jump - CMJ – the height of bounce, Squat Jump - SJ- the height of bounce, Running for 10 m from a high start, Running for 15 m from a high start and Running for 20 m from a high start. Applying this multivariate analysis of variance, the existence of statistically significant difference (P=0.00) in motor space has been established. With individual analysis of the difference the following differences in variables have been detected: Counter Movement Jump – the height of bounce (p=0.00), Squat Jump - the height of bounce (p=0.03) and Running for 10 m from a high start (p=0.05) in favour of football player. Statistically much higher level of factor for evaluation of explosive power of legs caused by the uniqueness of movements structure and uniqueness of the speed of movement and speed of reaction, the start acceleration, due to training processes, were noticed.*

Key words: *football; motoric, students; differences; adolescents;*

Introduction

Football as a complex sport abundant in most various types of movements is classified into a poly-structural, complex sports. In order to be able to perform all football tasks, a football player must, among everything else, have a certain level of motor abilities which is possible to happen only with the help of systematic physical condition practices (Smajic, Javorac, Molnar, & Barasic, 2014).

In most sport games and in individual sport, strength is one of the most dominant motor abilities (Pelemis, Ujsasi, Dzinovic, & Josic, 2018). Not a single movement nor action in sport activities cannot be carried out without manifestation of some form of muscle strength. The ability that enables an individual maximal acceleration of its own body, object or partner in activities is the explosive strength. This motoric ability can be defined as the ability of absolute excitement of maximal number of muscle units per unit of time, in a movement which is determined by a single giving of acceleration to its own body or outer object, and which results in the efficient mastering of spatial distance. One the explosive strength is one of dominant abilities in the field of sport, which is a matter of interest here, it must be properly diagnosed, selected from the population and further developed. The evaluation of motor abilities of football player presents one of significant factors of football talents identification and development. (Tomic, Smajic, Radoman, Vujovic, & Ivancic, 2012). In the process of training sport it is relevant to choose adequate operators (exercises), suitable for the target process which is made easier by respecting the general principles of training sport. Application of the principle of training sport in sport depends on the specific goals of training. The basic principles of training must not be observed separately, because

there is a tight relationship among them.They determine the content, means, methods and organization of training (Kalentic, Cvetkovic, & Obradovic, 2008).

The lack of information related to the factors which initiate and control the process of increasing of muscle mass and force with adolescents make it harder to precisely separate increasing of strength that came as a result of programmed training from the increasing which occurred due to maturing (Markovic, 2005; Ignjatovic, Radovanovic, & Stankovic, 2007). Some studies suggest that regular strength training results in lower total fat and increasing lean body mass (Zatsiorsky, & Kraemer, 2009).

The problem of difference in manifestation of motor abilities of football players and children who are not active in sport was something that many researchers dealt with (Bjelica, 2005; Kalentic, Cvetkovic, & Obradovic, 2008; Smajic, Javorac, Molnar, & Barasic, 2014) and confirmed positive influences of training processes on manifestation of, first of all, strength.

The protocols of explosive strength testing, type jumping, the so-called isoinertial dynamometry, are carried out with tests constructed in the form of vertical jumps with and without a burden, on the platform for measuring of force (Fratric, 2006). Tests and their results of evaluating different forms of explosive strength, type jumping, therefore, the specificity of each and every sport dictate the choice of tests in order to get a complete picture on sportsman (Milanovic, Jukic, & Vuleta, 2005). The explosive strength represents a significant factor in those activities in which it is necessary to provide great acceleration to the mass of body, of separate parts of body or outer object. This is mainly concerned with the activities of the following types: jumps (jumps in basketball, handball and volleyball, jumping disciplines and athletics etc.). (Newton, & Kreamer, 1994). Explosive strength in football must be very well developed in order for players to be able to adequately respond to the requests of the game itself. It is well-known that during the game, footballers often perform short sprints, quick twists, jumps and strong goal-kicks, which would be impossible to perform without developed explosive strength (Markovic, Dizdar, Jukic, & Cardinale, 2004).

The research problem is establishing differences in explosive strength of legs with children who train football and children who are not physically active in adolescent age. The aim of research is to determine any significant differences between adolescents who participate in sports and those who do not deal with explosive leg strength, while the subject of the research itself explosive leg strength. The research moved from the assumption that: H_1- there are statistically significant difference in manifestation of explosive strength of legs with children who train football and children who are not physically active in favour of football players.

Method

The sample of examinees made a total number of 44, male, age 12-13 (±6 months). The examinees who train football are members of FC “Novi Sad” (N=21) and at the time of conducting the tests, they had at least two years of sports experience dealing with the mentioned sport. Students who are not engaged in active sports (N=23) were people who regularly attend physical education in primary school "Dusan Radovic" from Novi Sad and sixth grades attend.

Performances of explosive strength of lower limps are estimated with the help of measuring on tanziometric platform “Kistler QuatroJump“ (Stojanovic, 2008). The sample of variables was made of: Counter Movement Jump - CMJ- the height of bounce (cm); Squat Jump - SJ – the height of bounce (cm); Running for 10 m from a high start (s); Running for 15 m from a high start (s) and Running for 20 m from a high start (s).

Measuring speed on 10, 15 and 20 m from a high start it was necessary to use the system of photo-cells (Beam Trainer QF11), they have the accuracy of measurements from1/100 seconds (Sudarov, & Fratric, 2010). Motor tests were planned in such way to avoid the influence of one test on the other. The first tests were implemented on tenziometrics platform, followed by tests running 10, 15 and 20 meters. Prior to any test, examinees were introduced with the test protocol in detail, after which there would be a practical presentation. Each examinee would have one trial attempt after which two more attempts followed. Only the better result was taken for statistical analysis. Besides these parameters, body weight and body mass of each and every examinee was measures. For measuring body height Martin anthropometer was used. The precision of this instrument is 0.1cm. The acquired values are expressed in centimeters (cm). For calculation of body mass a decimal digital scales will be used (Birotehna SD301).

Testing was carried out in the sport club where the football players practice, and which examinees who are not active in sport, it was performed in the school gym. Body mass and height are firstly measured, and then the examinees were submitted to the testing on tenziometrics platform. Anthropometric characteristics were measured directly before the testing of motor abilities. Prior testing on tanziometrics platform, the examinees were introduced in detail with the protocol of testing.

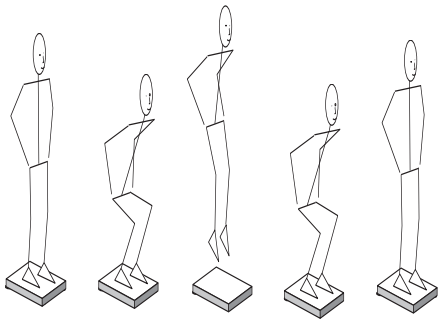
Testing Protocol

Counter Movement Jump- CMJ. During testing all phases of jump are connected, that is there was no break in the moment of changing the direction of movement. The examinees hands are fixed on hips in order to avoid the swing of hands that would facilitate the jump. Respondent is standing in upright position for a few seconds and from that position he lowers down in the position of counter movement jump (legs are flexed in knees under the angle of 90º) and without stopping in the moment of changing the direction of movement, he performs maximal vertical jump. What follows is soft landing with light flexion in knees. New taking of initial position followed. This test evaluates the eccentric-concentric component of the jump explosiveness (the height of jump measured in centimeters).

Squat Jump-SJ is performed out from a static position. The examinee's hands are fixed on hips in order to avoid the swing of hands that would facilitate the jump. Respondent is standing in upright position for a few seconds and from that position he lowers down in the position of counter movement jump (legs are flexed in knees under the angle of 90º) where he stands still for 2 seconds. After the still stage follows a maximal vertical jump, then landing with light flexion in knees. Taking the initial position follows. This test evaluates the concentric component of jump explosiveness (the height of jump measured in centimeters).

Picture 1. INSTRUMENT KISTLER QUATROJUMP

Picture 2. SHOW JUMP IN PHASES



For estimation of descriptive characteristics of variables there were the following calculations: arithmetic mean (AS), standard deviation (SD), minimal value (MIN), maximal

value (MAX) of the measured results. For estimation of normality of distribution in the analysed variables, Shapiro Wilk test was used. For establishing the differences in the explosive strength of legs between the groups formed in advance, the multivariance (MANOVA) and univariance analysis or variance (ANOVA) were used. Statistical significance will be established on the level $p \leq 0.05$. The acquired data are processed in a statistic package SPSS 20.0.

Results and Discussion

Table 1 shows the basic descriptive statistics for both groups of respondents. It can be noted that the sub-sample players on average higher (168.15±7.62 cm) relative to the sub-sample of pupils (166,13±8,04 cm), and that the value of the body weight less the football players (53.56±9.30 kg) compared to pupils (54.2 ±9.63 kg).

Analyzing the descriptive statistical parameters of motor variables in non-sporting students, one can conclude that the homogeneity of the results in all motor variables is noticed on the basis that in the tested motor variables three standard deviations can be classified into their arithmetic meanings. This is also the case in the sub player of the football player.

Table 1. DESCRIPTIVE STATISTICS OF VARIABLES

Variable	Group	MIN	MAX	AS	S	CV	SWp
Counter Movement Jump - CMJ- the height of bounce (cm)	F	23.63	38.46	30.05	3.63	12.07	0.54
	U	16.70	36.29	25.91	4.73	18.25	0.89
Squat Jump - SJ – the height of bounce (cm)	F	22.05	37.50	28.49	3.81	13.37	0.76
	U	19.13	39.01	25.38	4.86	19.14	0.30
Running for 10 m from a high start (s)	F	1.85	2.22	1.99	0.09	4.52	0.21
	U	1.84	2.34	2.06	0.13	6.31	0.88
Running for 15 m from a high start (s)	F	2.55	3.03	2.73	0.12	4.39	0.77
	U	2.54	3.19	2.83	0.18	6.36	0.89
Running for 20 m from a high start (s)	F	3.17	3.80	3.44	0.15	4.36	0.88
	U	3.20	4.02	3.56	0.23	6,46	0.84
Body mass (kg)	F	35.20	78.70	53.56	9.30	17.36	0.17
	U	37.50	71.00	54.28	9.63	17.74	0.56
Body height (cm)	F	151.70	182.60	168.15	7.62	4.53	0.94
	U	149.00	180.50	166.13	8.04	4.83	0.63

Legend: F – football players; U - students; MIN–minimal values; MAX–maximal values of the measured results; AS – arithmetic mean; S – standard deviation; CV – coefficient of variation, SWp – level of statistic Shapiro -Wilk test.

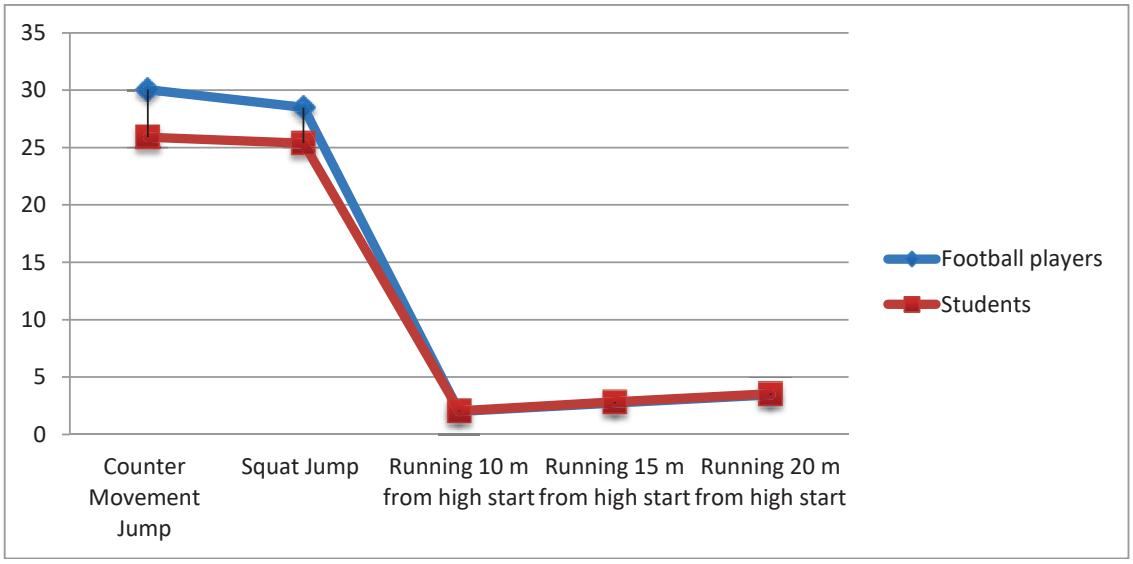
Based on F value (table 2) it can be concluded that there is a statistically significant difference (P=0,00) between the football players and students who are not active in sport regarding their motor abilities, observing the entire system of applied variables. By individual analysis of each and every motor variable, it can be concluded that there are statistically significant differences in the following variables: Counter Movement Jump - CMJ- the height of bounce (p=0,00), Squat Jump - SJ - the height of bounce (p=0,03), Running for 20 m from a high start (p=0,05) in favour of football players. In the remaining 2 variables some statistically significant differences were not established.

Table 2. DIFFERENCES OF DIFFERENT GROUPS EXAMINEES IN MOTOR VARIABLES

Variable	f	p	F	P
Counter Movement Jump - CMJ- the height of bounce (cm)	9.61	**0.00**		
Squat Jump - SJ – the height of bounce (cm)	5.05	**0.03**		
Running for 10 m from a high start (s)	3.84	0.06	**2.44**	**0.05**
Running for 15 m from a high start (s)	3.51	0.07		
Running for 20 m from a high start (s)	3.83	**0.05**		

Legend: f – univariance f test; p – level of statistical significance of f test; F – multivariance i Wilk's F test; p – statistical significance of multivariance F test.

Graph 1. AVERAGE VALUES OF MOTOR VARIABLES



Research investigations were carried out on a sample of 21 players from Novi Sad and 23 sixth grade students who do not pursue primary school "Dusko Radovic" from Novi Sad, in order to establish the differences in the field of explosive strength of legs. The survey results point out to the existence of statistically significant differences (P=0.05) in the entire motor area and which indicate the acceptance of the set research hypothesis (H_1). Guided with the training processes in the period of about 2 years and a continuous work, the examinees who are training football showed during measurements far better average values in variables for estimation of vertical jumps: Counter Movement Jump – CMJ - the height of (p=0.00), Squat Jump - SJ – the height of bounce, and in those variables there were the most prominent statistically significant differences in relation to students who are not engaged in sports. The structure of movement itself in football, abundant in starts, jumps for the ball and head kicks, speed-ups, caused statistically far better results of manifestations of explosive strength in the test of Running for 20m from a high start in favour of football players. Such acquired data confirms the so-far results Bjelica (2005) who also established the existence in compared to non-athletes of manifesting difference in favour of football players in the field of strength, explosive strength. Furthermore, the correlation was found with the research of Joksimovic, Joksimovic, & Bojic (2016) who established some higher level of manifestation of explosive strength in the test Running for 20 m from a high start and explosive strength manifested through test of Long jump. Although there were no statistically significant differences in tests

of Running for 10 and 15 m from a high start, it should be pointed out that the football players had in these variables on average far better results in relation to students who are not engaged in sports, which confirms that for football, explosive strength is extremely significant (Lolic, Bajric, & Lolic, 2011).

Although the processes of maturing are inevitably present in the development of every young organism, with organized and guided physical activity you can increase in an efficient way positive influence of process of maturing on the development of certain motor abilities. With adequate choice of means and the right quantity of burden during the adequate time duration in certain sensitive periods of growth and development of young football players, some key training influence are produced. Thanks to those influences in the adult age some maximal genetic potentials can be reached. By missing to react duly, motor abilities of future football players will most definitely stay on a lower level than maximally possible. Critical periods of growth and development are highly sensitive with influences of guided training burdenings, they are called sensitive periods and are different for different motor abilities.

The success in every field, and in the field of sport as well, is the result of a planned and arduous work. All successful top sportsmen are trained individuals who excel in their activities and follow well-prepared long-term plan of training in the course of many years. Training is the basis of process of progressive exercising that improves the potential of reaching the optimal results. For football players those are long-term programmes for development of physical condition of body and mind which lead to perfection of performance in its sport field. Apart from the training competence for annual planning of training process, it is very important to look further and perform long-term planning of development of football player. Football players should, together with his coach, start this process in the young school age so that he could progressively perform growth of body and mind thereby coming to the ultimate success, observing everything from a long-term perspective.

From theoretical point of view, the work should help with the choice of parameters of motor field which should be followed in the work with younger categories of football players as well as with the choice of adequate motor tests which could be applied in everyday work.

Conclusion

This work could contribute the anthropological disciplines like biological anthropology and anthropomotorics, sport training and it could be reflected in the analysis of stage of certain motor abilities. The work can help trainers in the selection of suitable motor tests that can be adapted, because on the basis of the obtained results, it would be possible to plan and program possible corrections in the training process as well as teachers in schools because part of the teaching process could be directed towards raising the level of explosive power boy, because explosive power makes dominant ability in complex both cyclic and acyclic activities.

Acknowledgements

The work was created within the Teacher Education Faculty, University of Belgrade, project titled "The concept and strategy of providing quality basic education" (179020), funded by the Ministry of Education and Science of the Republic of Serbia.

Statement

The authors have equally contributed to the paper.

Conflict of interest

We declarate there is not conflict of interest between authors.

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